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Comments Regarding Atlantic Richfield Company's Reference Area Technical Memorandum, Leviathan Mine Site, Alpine County, California

Thank you for the opportunity to comment on Atlantic Richfield Company's July 17, 2017 *Reference Area Technical Memorandum,* for the Leviathan Mine Site. California Regional Water Quality Control Board, Lahontan Region (Water Board) staff has the following comments:

1. Page 6, Section 2.3, number 2 – The report did not provide the "estimated numerical values" that were generated to replace the non-detect values for the ten different media evaluated in the report. Please include these values in the report.

2. Page 6, Section 2.3, number 3 – Submit all ProUCL outputs and criteria used to determine when to pool and when to segregate data sets for all media.

3. Page 6, Section 2.3, number 4 – ProUCL Version 5.1, Technical Guide, page 38 guidance on determining outliers states, "In environmental applications, outlier tests should be performed on raw data sets, as the cleanup decisions need to be made based upon values in the raw scale and not in log-scale or some other transformed space." Water Board staff has observed that a number of datasets were transformed into a normal distribution before running the outlier test, which does not follow the above-referenced guidance and tends to mask outliers and skews calculations of Reference Threshold Values (RTV's). For example, when the ProUCL outlier test is performed on Tsib arsenic raw data for reference mine waste, the values of 1,180 mg/kg-dw and 1,120 mg/kg-dw are identified as outliers. Atlantic Richfield

Company's outlier analysis for Tsib arsenic from 0-2 feet below ground surface (bgs) was not performed on the raw data set and did not identify these two values as outliers.

The basis for deviating from the ProUCL's guidance referenced, above, is unclear. The report should clearly identify when analytical methods deviate from applicable methodology guidance/protocols, and either provide a well-supported technical justification for doing so, or perform the analysis in accordance with applicable methodology guidance/protocols. Making such information readily available will allow reviewers to more efficiently identify instances where methodology guidance/protocols are not being followed, evaluate the justification for the alternative analysis, and develop conclusions regarding the suitability of using the alternative analysis.

4. Page 6, Section 2.3, number 5 – The report states that Upper Simultaneous Limits are recommended by USEPA when the dataset is without outliers. The report indicates that the data was transformed with the Box-Cox transformation to develop a normal distribution and then the outlier test was performed on the transformed data. The result is that the outliers were not identified and the full dataset with outliers was used to develop the RTV estimate. Additionally, the statement that RTV's were calculated on non-transformed data is not accurate. The data was again transformed prior to the calculation of the RTV. As stated in Comment No. 3, above, the report should clearly identify when analytical methods deviate from applicable methodology guidance/protocols, and either provide a well-supported technical justification for doing so, or perform the analysis in accordance with applicable methodology guidance/protocols.

5. Page 6, Section 2.3, number 5 – One additional point on distribution selection is included in the ProUCL guidance, page 38. When both Gamma and Lognormal distributions fit the acceptance criteria, the use of Gamma distribution based decision statistics is preferred to estimate the environmental parameters (RTV) over lognormal distribution based RTV estimations. ProUCL guidance includes the following regarding lognormal distributions. "A lognormal model tends to hide contamination by accommodating outliers…" and "The use of the lognormal distribution on a dataset with outliers tends to yield inflated and distorted estimates which may not be protective of human health and the environment…" For example, the arsenic Tsib 0-2 feet bgs RTV result provided in Table 3-3 is 4,081 mg/kg-dw. When the outlier test is performed on the raw data set, the values of 1,180 mg/kg-dw and 1,120 mg/kg-dw are identified as outliers, removed from subsequent analysis, and then using the Gamma distribution, a RTV result of 1,488 mg/kg-dw is produced. This example shows the significant effect analytical methodology selection can have on the results. As stated in Comment No. 3, above, the report should clearly identify when analytical methods deviate from applicable methodology guidance/protocols, and either provide a well-supported technical justification for doing so, or perform the analysis in accordance with applicable methodology guidance/protocols.

6. Page 9, Section 3.1.1, first paragraph – Several of the reference site locations identified in the report are in close proximity to areas that were actively mined and/or are known to have mine waste materials. Additionally, constituent concentrations, such as those for arsenic from reference site locations, are in several cases[1] comparable to arsenic concentrations in mine waste soil samples taken from actively mined areas or those with known mine waste materials (Figures 6-2, 6-3, 6-C-5, and 6-C-6 from the April 23, 2016 Mine Waste Technical Data Summary Report). When evaluating Figures 6-2 and 6-3, it appears that the highest concentrations of arsenic (range of 340 – 1,900 mg/kg) are surrounding most of the reference area mine waste sampling locations that also have arsenic concentrations in the same range. This combination gives cause to call into question if all of the currently identified reference site locations should remain identified as such, or should some of them be reclassified. Given this situation, there is substantial potential that one or more of the currently identified reference site locations will need to be reclassified, creating a data gap in the reference area analysis that will need to be addressed.

   Additionally, the criteria for determining if a currently identified reference site location has or has not been affected by past mining operations and/or mine wastes is absent. Such information needs to be provided and evaluated to determine if the criteria is suitable for identifying which sites have and have not been affected by past mining operations or mine waste. The criteria used for this analysis is critical to identifying suitable reference sites/areas, and if there are remaining data gaps regarding the reference areas.

7. Page 11, Section 3.2.2, number 5 and Table 3-3 – The applicability of the statistical methodology for the 95% Upper Simultaneous Limit used is questionable. For example in Table 3-3, the range of concentrations detected for arsenic in the Tsib formation ranges from 24.2 – 1,180 mg/kg-dw, which produces a RTV of 4,081 mg/kg-dw. This value is almost four times the highest concentration of the data population, which would appear to be inappropriate for setting reference concentrations for the Remedial Investigation/Feasibility Study (RI/FS). While Water Board staff defers to USEPA on the appropriate statistical method to use, the RTV should be representative of the associated data set for each media sampled. How will this RTV be compared to potential site-impacted media? Will it be compared to a 95% upper confidence limit estimate of the mean or discrete data points or some other statistical value?

8. Page 14, Section 4.1 – In addition to sampling the four monitoring wells (MW-48, MW-49, MW-51, and MW-53) on a monthly basis in 2017, will monitoring wells MW-45 and MW-46 also be sampled on a monthly basis in 2017? If not, what is the rational for not sampling MW-45 and MW-46?

[1] Data provided in Table 3-2 shows for arsenic that the maximum concentrations for reference site location depth intervals of 0-0.5 feet bgs, 1.5-2 feet bgs, 2-4 feet bgs, and 4-6 feet bgs are 1,180 mg/kg-dw, 832 mg/kg-dw, 559 mg/kg-dw, and 874 mg/kg-dw, respectively.

9. Page 14, Section 4.2, first paragraph and Figure 4-1 – The text states that monitoring wells MW-45 and MW-46 are "reference wells" and that there is significant variability in metals concentrations between these two "reference wells." Reviewing the data presented in Appendix 4A for MW-45 and MW-46, it draws into question if MW-46 meets the criteria for reference wells as described in Section 4.0 (second bullet – "the monitoring well is located outside of the effects from mining-disturbed areas"). When comparing the dissolved arsenic concentrations of MW-46 with other site-impacted monitoring well data (contained in Figure 7-1 from the January 25, 2017 Groundwater Technical Data Summary Report Version No. 2), the value of 14.4 mg/L is greater than any other dissolved arsenic concentration data from both RI and historical measurements. It does not seem appropriate to identify MW-46 as a reference well at this time, as there have only been two sampling events which showed two orders of magnitude difference in sampling results. Additionally, Figure 4-1 should be updated as MW-45 and MW-46 are designated as "reference wells;" however, it appears that it is premature to make that designation.

   This is not the first time that identifying MW-45 and MW-46 as reference wells has been questioned. It is Water Board staff's position that based upon existing data, it is premature to designate these two wells as reference wells at this time, and that they should be identified as preliminary reference wells. Water Board staff previously commented in its March 27, 2015 *Comments on Atlantic Richfield Company's Revised Draft Final Reference Area Focused Remedial Investigation Work Plan dated February 28, 2015,* comment number 4 – "There is also concern that the proposed reference wells [MW-45 and MW-46] could be within the area where the water table has been depressed by Tunnel 5, as described in the Pit Area Hydraulic Evaluation (Appendix D)." In Atlantic Richfield Company's August 14, 2015 *Response to U.S. EPA and LRWQCB Comments on Draft Final Reference Area FRI Work Plan and Technical Memorandum – Preliminary Investigations in Reference Study Areas*, Atlantic Richfield Company states (response to comment G5), "The groundwater data from locations LOC-35 and LOC-36 will be used with existing RI and historical groundwater-related data (including data from existing monitoring wells and piezometers) to evaluate reference groundwater conditions, inform decisions about whether data gaps exist, and determine the need for additional reference wells (shallow and deep) in other hydrostratigraphic units." What is Atlantic Richfield Company's plan for reference groundwater wells in light of the results that have been presented thus far?

10. Page 16, Section 5.1.1, last sentence of section and Figure 5-1 – Reference surface water sampling locations should be labeled correctly in Figure 5-1. Please update the legend.

    It is unclear if the preliminary reference surface water sampling locations are considered in the calculation of RTVs. Additionally, Appendix 5A includes the analytical results for the reference surface water sampling locations; however, sampling locations SW-52 and SW-53 are not included in Figure 5-1. Please include or explain why these sampling locations are not included.

11. Page 17, Section 5.2.2, number one, and Figure 5C-1 and Figure 5C-2 – The text in this section describes the evaluation of surface water reference data and states the data from the five reference area creek reaches were compared using box plots and that "Based on this evaluation, it was assumed that the samples from the upstream reaches of Aspen and Leviathan Creeks were sufficiently different from the other RSA locations and could potentially be evaluated independently for the purpose of developing RTVs." When looking at Figure 5C-1 and Figure 5C-2 for dissolved and total arsenic, it appears that the concentrations found in Cottonwood Creek are over double what is found in the other reference area creek reaches. It is unclear why the upstream reaches of Aspen and Leviathan Creeks were evaluated independently from Mountaineer and Cottonwood Creeks when looking at the box plots in Appendix 5C. Please provide the justification for this approach.

    It appears that Cottonwood Creek tends to have fewer similarities in concentrations with the other reference streams and perhaps should have been evaluated independently. If this was to be the case, how would the results of this analysis change?

12. Page 18, Section 5.2.2, number 3 and 4 and Tables 5-3A, 5-3B, 5-4A, and 5-4B – The text in number three explains that the dissolved and total arsenic concentrations showed evidence for two subpopulations with the Cottonwood/Mountaineer Creek data set, which resulted in three different RTVs. This gives the RTVs for dissolved arsenic (Tables 5-4A and 5-4B) as 0.00426 for Upper Leviathan and Aspen Creek, 0.0027 for Mountaineer Creek, and 0.0091 for Cottonwood Creek (Cottonwood RTV is over double the other two values). It is unclear in this report how having multiple RTVs will be utilized/applied in the RI/FS. Please clarify.

13. Page 19, Section 6.1, second sentence and Table 6-1 – The text states, "…the sampling goal was to collect stream sediments in reference stream reaches that were sufficiently similar to stream sediments in potentially affected areas of the On-Property Study Area and the DSA." While this goal seems appropriate, only having two reference streams where sediment data was collected appears to be a limitation and appears to result in a potential data gap. Included in Table 6-1, the maximum concentrations of arsenic for the three reference stream reaches sampled are 7.47 mg/kg-dw (Lower Mountaineer Creek), 20.2 mg/kg-dw (Upper Mountaineer Creek), and 37.3 mg/kg-dw (Cottonwood Creek). The Cottonwood Creek concentration is almost double the concentration of Upper Mountaineer Creek and almost five times the concentration of Lower Mountaineer Creek and raises concern in evaluations of how "sufficiently similar" this stream sediment actually is. Additional stream sediment collection on Upper Leviathan and Upper Aspen Creeks would allow for an evaluation of the appropriateness for Cottonwood Creek sediment to represent reference concentrations.

14. Page 19, Section 6.1.1, first paragraph – The sampling depth of the upper 2-3 centimeters of sediment in the reference streams does not account for the shortfalls of this sampling approach by only focusing on recently deposited sediment. As

previously questioned in Water Board staff's March 27, 2015 *Comments on Atlantic Richfield Company's Revised Draft Final Reference Area Focused Remedial Investigation Work Plan dated February 28, 2015,* comment number 6 – "How will the 2-3 cm sample depth characterize the extent of mine waste within the stream sediment when elevated metal concentrations have been found at deeper depths?" This question was not adequately addressed, resulting in additional comments in Water Board staff's August 31, 2015 *Comments on Atlantic Richfield Company's Response to U.S. EPA and LRWQCB Comments on Draft Final Reference Area Focused Remedial Investigation Work Plan and Technical Memorandum – Preliminary Investigations in Reference Study Areas dated August 14, 2015,* comment number 6 – (reproduced below)

> "This response does not appear to address the shortfalls of the sampling approach by only focusing on recently deposited sediment. Additionally, the EPA comment letter dated November 21, 2011, states:
>
> > 15) Section 5.2.2 Stream Sediment Sampling. The text describes sampling the upper two centimeters of sediment to "…obtain baseline data for sediment of recent deposition…" While recent deposition is of interest to the RI, knowledge of older deposition is also of interest. For example, if sediment originated prior to site stabilization during the mid-1980s contains elevated chemical concentrations compared to more recent sediment, then older sediment may pose an unacceptable threat to the environment. Therefore, the stream sediment DQO and sampling must be revised to include evaluation of deeper (and presumable older) sediment to allow comparison with deeper and older sediment within the Leviathan and Bryant Creek watersheds downstream from the site.
>
> Again, how will the in-stream sediment beyond the 2-3 centimeter depth be evaluated as part of this work plan?"

This appears to continue to be a shortfall of the stream sediment sampling approach and is in need of additional sampling of older and deeper sediment that is within the stream channel, not to be confused with floodplain sampling as was included in Atlantic Richfield Company's response. This is a very important data gap that requires additional sampling to meet the DQO Problem Statement for stream sediment, which states, "In order to determine the **extent** [emphasis added] of potential site-related impacts to on-property and off-property stream sediments, COPC/COPEC concentrations in stream sediments in reference areas that approximate ambient conditions are needed to support comparisons to affected areas and human health and ecological risk evaluation (including estimates of incremental risk above ambient conditions); sampling results will also be used in remedy selection decision making." How will the stream sediment beyond 3 centimeters be evaluated to meet the DQO, above?

15. Page 20, Section 6.2.1 and Appendix 6A – There were 50 stream sediment samples collected from the three reference stream reaches with 8 samples collected from the Upper Mountaineer Creek, 15 samples collected from the Lower Mountaineer Creek, 27 samples collected from Cottonwood Creek, and no samples collected from Upper Leviathan or Upper Aspen Creeks. This sampling strategy seems very disproportionate and leads to concerns about representativeness of the data collected and its applicability. As previously commented in Water Board staff's March 27, 2015 *Comments on Atlantic Richfield Company's Revised Draft Final Reference Area Focused Remedial Investigation Work Plan dated February 28, 2015,* comment number 7 – "It is unclear why over half of the sediment samples that are proposed to be collected are located in Cottonwood Creek. The number of samples for Mountaineer Creek seems disproportionate based on the number of Downstream Area reaches it is proposed to be applied to."

    Water Board staff continues to express its concerns regarding the failure to retain Upper Leviathan and Upper Aspen Creeks as reference streams, as it has on multiple occasions in previous comment letters during the development of the Reference Area Work Plan. Staff's concerns are further supported by the resulting absence of stream sediment sampling in Upper Leviathan and Upper Aspen Creeks, the actual creeks directly impacted by past mining activities and mine waste disposal practices. Additionally, sampling results presented in Appendix 6B, specifically Figure 6B-2 – 6B-6 (Boxplot Comparisons of Reference Sediment Reaches) show what appears to be 13 (Arsenic, Barium, Beryllium, Total Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Mercury, Nickel, Selenium, and Thallium) of the 20 RI/FS metals being noticeably higher in Cottonwood Creek than Mountaineer Creek, calling into question the decision to retain Cottonwood Creek and not Upper Leviathan and Upper Aspen Creeks. Additional stream sediment data collection on Upper Leviathan and Upper Aspen Creeks could augment this data set to ensure that "sufficiently similar" stream reaches are sampled. Are there any plans to collect stream sediment data from Upper Leviathan and Upper Aspen Creeks?

16. Page 20, Section 6.2.2, numbers one, three, and five and Table 6-2 – The report summarized that the results for the stream sediment sampling were sufficiently consistent to be pooled for use in calculating the RTVs for stream sediment, although as commented, above (Comment No.15), there is concern with this sampling approach (disproportionate amount of samples from Cottonwood Creek and no samples from Upper Leviathan or Upper Aspen Creeks). As an example in Table 6-2, for arsenic, the maximum concentration in stream sediment was 37.3 mg/kg-dw, which results in a RTV of 68.5 mg/kg-dw. Given that the RTV of 68.5 mg/kg-dw is almost double the highest concentration found in stream sediment calls into question the statistical approach.

17. Page 23, Section 7.2.1 and Tables 7-2 and 7-3 – Similar to the concern with limited reference stream sediment data in the comments above, there appears to be a limitation of reference floodplain soil data as well. Table 7-3 includes results from the three reference stream reaches in 2-6 feet bgs depth interval, and the maximum

concentration for arsenic is 5.25 mg/kg-dw for Upper Mountaineer Creek, 5.42 mg/kg-dw for Lower Mountaineer Creek, and 21.8 mg/kg-dw for Cottonwood Creek. Cottonwood Creek concentration is almost four times the concentration of Upper Mountaineer Creek and Lower Mountaineer Creek. Additional floodplain soil data collection on Upper Leviathan and Upper Aspen Creeks could augment this data set to ensure that "sufficiently similar" stream reaches are in-fact sampled. Are there any plans to collect floodplain soil data from Upper Leviathan and Upper Aspen Creeks?

18. Page 25, Section 7.2.2 number 5 and Tables 7-2 and 7-4 – Table 7-2 includes the highest concentration of arsenic in Lower Mountaineer Creek with a value of 33.1 mg/kg-dw. However, when looking closer at the data included in Appendix 7A, this data point appears to potentially be an outlier as the next highest value in the table for Lower Mountaineer Creek is 8.92 mg/kg-dw. Similar to the situation discussed in Comment No. 3, above, the outlier test was not performed on the raw data. What is unclear is how the data was analyzed, so that in this case, what appears to be an outlier was not identified as such. The subsequent analysis that included the maximum arsenic concentration of 33.1 mg/kg-dw produced a RTV value of 42.5 mg/kg-dw, which does not seem to coincide very well with the data presented in Appendix 7A.

    It appears that this may be another example where the analysis deviates from applicable methodology guidance/protocols. As stated in Comment No. 3 and other comments, above, the report should clearly identify when analytical methods deviate from applicable methodology guidance/protocols, and either provide a well-supported technical justification for doing so, or perform the analysis in accordance with applicable methodology guidance/protocols.

If you have any questions regarding these comments, please contact Hannah Schembri, Water Resource Control Engineer, at hannah.schembri@waterboards.ca.gov or (530) 542-5423, or me at scott.ferguson@waterboards.ca.gov or (530) 542-5432.

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